Data Redundancy on Diskless Client using Linux Platform

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ABSTRACT

This paper addresses the redundant array of inexpensive/independent disks (RAID) in the field of diskless clients' where the centralized Disk Less NFS Server is present to share the OS bit to diskless clients over TCP IP over Local area network. Disk less client technology is very much practical and useful where a cost efficient and low end clients can be made useful without presence of a local disk itself. The clients which has the whole low end Computer system i.e. Keyboard, mouse, CPU + motherboard, monitor and may or may not have a disk can still use the advantages of RAID system through the diskless client server in such a way that any disk faults can be tolerated online. The underlying present disk (if any) in diskless client can also be used for specific purposes.

General Terms

The Disk Less Client is a technology used for ease of administration. The scope of this paper will be only for Software oriented Virtual Disk Less clients.

Keywords

RAID, disk less clients, redundancy, Mirroring, Fault Tolerance, latency, hardware and software data storage, data syncing, master-slave disks.

INTRODUCTION

Redundant array of inexpensive/independent disks i.e. in simple words, RAID, is very much aware term in computing world where data is more important instead of cost.

The high value data must be kept alive without any corruption, so the only possible ways are to either get data backed up on regular basis, and confirm the backed up data is restorable or not, or get the RAID system in place.

RAID is nothing but the methodology to keep the data copy on another disks in order to tolerate the faults. Fault tolerance ratio depends upon the number of disks and architecture of RAID system in use. Centralized Server is running on top of the highly effective hardware, there won't be performance degradation and the Guest Image running on top of the server can be easily managed. This makes System Administrators identify/create/modify/deploy anything in Single Clicks. One doesn't need to worry about the HDD corruption of the Client machines because there won't be any HDD on the same. Single Instance hosted at Centralized server makes it simple to maintain secure and robust as well. As it will be cost effective, the Corporate Industries can invest more on Human Resources thus better paying jobs. Understanding RAID and Disk less Clients in short:

RAID :

Redundant array of Inexpensive/Independent disks is nothing but an architecture of disks attached together to perform fault tolerance technique for data. RAID architectures can be managed by direct software or by hardware. Software Managed RAID Architectures are called as Software RAID (mainly maintained by Operating system and is an overhead for Operating system to manage it) whereas Hardware Controller Managed RAID Architectures are called as Hardware RAID, where a special device called as Hardware RAID Controller is placed on Motherboard situated in between the Data Bus and the Disks. This Hardware RAID controller is responsible for all data writes and data reads, so Operating system is free to invest it's resources somewhere else while being in execution.

1. LITERATURE REVIEW

Disk less clients are the hardware low end systems which can run a specified Operating system presented by Disk less client server system over the IP NFS protocol. The Disk less client server hosts the chrooted (OS inside OS) image of stripped down or required package set Operating system over the network using network file system protocol and a network dracut image. These clients will boot from Network Interface cards to get the IP information from one of the DHCP server, making them a part of the desired network. The same DHCP server along with IP information, will provide the TFTPBOOT path for the clients to boot the system with the pre-existing OS on Diskless client server network. The Complete Image of chrooted and exported Operating system will be copied to the Physical memory (RAM) of the clients and will be loaded. The login information, the file system and the data to be operated will be present on the server's chroot OS and clients can make use of it.

This paper addresses the Technical Collaboration of RAID Technologies and Disk Less Client Configuration altogether to form a fully functioning production ready setup.

Diskless Technology is the client computers will not use hard disk drive. These clients are connected with the high speed network, run the file system from the server's hard disk simulation. With the help to this system client can manage the resources easily from client side, but due piracy problem some resources cannot be directly access by the client. The virtualization technology offers applications an abstract view through interfaces of the hardware platform and resources. Virtualization has several benefits for enabling cloud

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computing. The hypervisor is a program of virtualization which handles the protection among virtual machines; hence applications can be easily migrated on different virtual machines without isolation of host integrity. Virtual machine architecture having six major types i.e. Full Virtualization, Hardware assisted virtualization, Para Virtualization, Operating System Level Virtualization, Application Level Virtualization and Network virtualization, in this research paper we are using the concept of Network virtualization to implement the diskless client and zero hardware environment for computer laboratories[1]. Distributed resource manager concept helps us to improve the scalability of operating systems which will be access by the client during run time environment. The Operating system will be residing on the Host OS on Remote normal/RAID storage as per the requirements. This will be shared using NFS protocol and will make sure to be accessible outside the HOST Operating System [2]. The Network used here will be of 10GBPS at least, because the OS will be transferred over the network itself. This will be a local area network which will take care of the total transfer of the data over Ethernet. The Diskless Clients will boot from network and will request for the DHCP IP address by sending an ARP (Address Resolution Protocol) packets broadcast over the network. This DHCP server will provide the IP address using DORA process and along with the DHCP IP address, the next-server IP address will also be shared here which will be the IP of the same HOST OS which shares the Guest OS image using NFS [3] in this article operating system having dynamic IP address so that user not having rights to change the IP, after restarting the operating system IP can be changed every time.

The TFTP Server will host the PXE kernel as well as the Guest OS kernel along with the network initrd.img files in the menu listing. The PXE kernel will be transferred via tftp server and that kernel image will read out the menu file thus moving to the NFS shared image of the Guest OS. The NFS protocol will be used to share the Guest Image of the OS for Disk Less Clients. Once the menu listing is loaded, the system will transfer the NFS hosted Guest OS image over network. The Client machines are the machines which just have Central Processing Unit, Monitor, Keyboard, Mouse but not the HDD. The system will boot using network, so network boot enabled NICs are required too. In order to keep the Host OS secure and robust, the Proxy and firewall is required. The firewall will have ports open for DHCP, NFS and TFTP services [3].

Server virtualization brings revolutionary changes to the data centers and it will provide the high speed connectivity during accession of operating systems from remote locations, currently Amazon provides full operating systems as pay as peruse concept but not affordable to the small scale and other offices. Integrating servers by virtualization can significantly reduce the space and power consumption, enhances the IT services, simplify the hardware management so that virtualization term is very much popular in the business market.[4]. Cloud computing, and particularly the use of public clouds, brings advantages on the technical, environmental and business sides, allowing multiple under-utilized systems to be consolidated within fewer physical servers hosting them. A cloud provider can manage physical resources in a very efficient way by scaling on the several hundreds and thousands of customers [1, 4].

2. PROPOSED SYSTEM

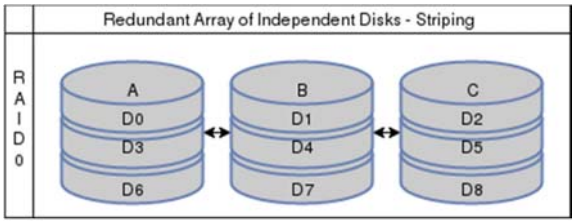

Figure 1. Proposed Diskless Systems Using RAID 0 Architecture.

RAID Architectures

The RAID configuration architecture depends on the way the disks are attached together and data is written on top of them. The major primary RAID architectures are as follows. Rest all RAID architectures are combination of following three major RAID architectures.

RAID 0 : Striping of Data.

a. The RAID0, also called as Striping of Data RAID, architecture consists of minumum two or more disks.

b. The motive here isn't for fault tolerance but to make Operating System think of many small disks as one through RAID0 architecture. I.e. maximum use of available disk space.

c. Fault tolerance isn't present in RAID0

d. The data is written across disks.

e. Write and read operations both are faster.

f. The architecture looks as follows.

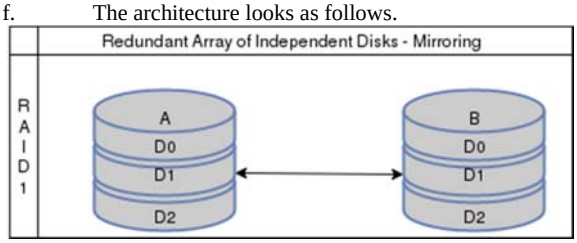

Figure 2. . Proposed Diskless Systems Using RAID 01 Architecture.

RAID 1 : Mirroring of Data

a. The RAID1, also called as mirroring of Data, architecture consists of two disks by maximum.

b. The motive here isn't the maximum disk space usage but to have maximum fault tolerance.

c. Fault tolerance is 100%

d. The data is copied across the other disk as a mirror copy.

e. Write operation is slower than read operation.

f. The architecture looks as follows.

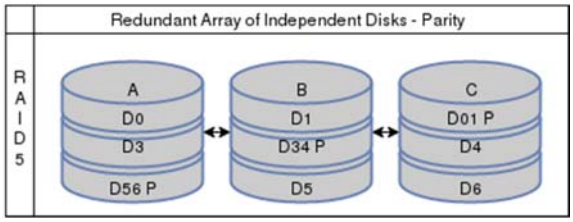

Figure 3. **. Proposed Diskless Systems Using RAID 5 Architecture**.

RAID 5 : Distributed Parity of Data

a. The RAID5, also called as distributed Parity of Data, architecture consists of exact three disks .

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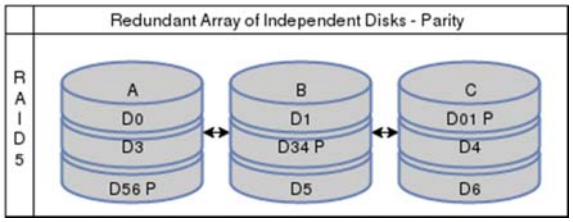
b. The motive here is to use the maximum disks with fault tolerance.
c. Fault tolerance is 66%
d. The data is wrote across two disks and an equivalent parity is written on third. This parity is written across each disk on sequential basis, so called as distributed parity.
e. Write and read both are faster.
f. The architecture looks as follows.



3. IMPLEMENTATION

In Order to have a working prototype of a Disk Less Client in-house, following requirements needs to be full filled. A CentOS6 as a base machine is required to be used as a HOST OS which will serve as a Parent holding almost all the services which will be required by the Disk Less Client as shown in above Diagram. The same server will host the Local Repository of the Packages which will be deployed during GUEST image creation. The Services like DHCP (Dynamic Host Control Protocol), PXE (Pre-boot), TFTP and NFS will be running on the same HOST OS Machine too.

The Proof of Concept can be implemented as follows.

1. Install CentOS 6 machine with minimum 20GB free space and make sure it has a static IP address *192.168.0.254* (or whatever), we took *192.168.0.254/24* as the IP address for this Server

2. After installation, attach the CentOS 6 DVD to the machine, and mount it on the server.

Diskless Client and RAID 1 :
Diskless client server's TFTPBOOT directory which hosts the chrooted Operating system image for booting purpose of the diskless clients, can be created as a RAID 1 - Mirroring Device which will give maximum fault tolerance over the site in case of any disk goes faulty. No downtime required for any operations here for recovery. The architecture will look as follows.

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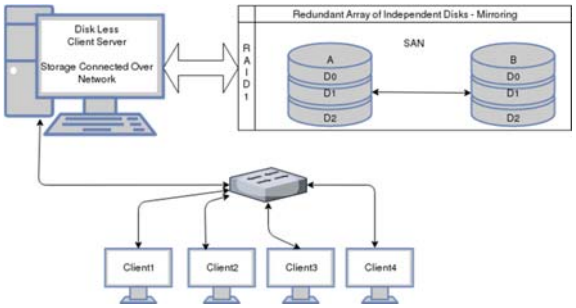

Disk Less Client Server Chrooted OS on a Storage Area Network connected through high fibre channel connection and in RAID1 System enables the system highly efficient for Fault tolerance making it one of the best design for maximum read speed over the clients. In above scenario, the OS itself is managing the RAID1 over the network for writing and exporting the OS.
A diskless Client machine can be created using Kickstart snippet below for fully functioning RAID 1 mounted under /var/lib/tftpboot directory as follows. Along with OS partitioning, the disks /dev/sdb and /dev/sdc is used for RAID1 to be mounted under /var/lib/tftpboot/ directory for diskless client chroot OS.

Kickstart Snippet for Automated Installation for Diskless Client's RAID volume

```
# Install bootloader on MBR of sda disk i.e. local disk of the system.
bootloader --location=mbr --driveorder=sda,sdb,sdc --append="crashkernel=auto rhgb quiet"

# clear all disks i.e. sda which is local disk and sdb, and sdc which are SAN block devices.
clearpart --drives=sda,sdb,sdc --initlabel

# create /boot, swap and pv.00 on /dev/sda as primary devices for System Volume.
part /boot --size=1000 --ondisk=sda --asprimary --fstype=ext4
part swap --size=1000 --ondisk=sda --asprimary --fstype=swap
part pv.00 --size=10000 --ondisk=sda --grow --asprimary

# create a SystemVol volume group
volgroup SystemVol pv.00

# create three logical volumes for root, home and var
logvol / --vgname=SystemVol --size=6000 --name=rootvol
logvol /home --vgname=SystemVol --size=2000 --name=homevol
logvol /var --vgname=SystemVol --size=5000 --name=varvol

# Another part of kickstart to create RAID1 on top of sdb and sdc directly
part raid.0001 --size=5000 --grow --ondisk=sdb
part raid.0002 --size=5000 --grow --ondisk=sdc
raid pv.01 --device md1 --level=RAID1 raid.0001 raid.0002

# create a volume group out of the RAID volume pv.01 for diskless client
volgroup DISKLESSVol pv.01

# Create and mount the RAID LVM on /var/lib/tftpboot for 100% fault tolerance.
logvol /var/lib/tftpboot/ --vgname=DISKLESSVol --size=6000 --grow --name=disklessclientvol
```


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4.1 COMPARATIVE ANALYSIS

Table: 1 Comparative Analysis

Characteristics	Thin Client	Thick Client	Diskless Client using RAID
Low Watt Power Supply	Good	Poor	Good
Energy Efficiency	Good	Poor	Good
CPU Capacity	Poor	Good	Good
Cost	Medium	Poor	Excellent
Availability	Medium	Good	Good
Support	Good	Good	Good

We have checked the performance of diskless client using open source architecture along with existing technologies available in the market, we can connect more than 1000 systems where as other technologies having some limitation while connecting more than 100 systems, we have calculated the performance of the technologies such as thin client, thick client and diskless client supported with open source architecture as per the characteristics shown in the table 1.1

Many of the aspect related with the speed, Availability, Graphics, Energy our solution is good. The most important part to understand in the *POC* is the *dracut* network image. If the root partition is on a network drive, one has to have the network *dracut* modules installed to create a network aware *init image*. This initramfs.img gets downloaded using *tftp protocol* and then creates an environment in Physical Memory in order to create a feasible environment for mounting the further file systems.

Why we are promoting open source because we all know paid operating systems cost is not affordable to any section like school, colleges, universities, offices, industries etc. and this cost is increasing day by day, we need have a stable operating system and stable hardware cost also, but the scenario is different the cost of hardware is also not affordable, if we installed this solution to above said area it will save cost energy and affordable to the mass education and every on can dream for free operating systems and every one can happy to learn the computer system without any trouble.

4. CONCLUSION

The design of Diskless client with the RAID 1 Mirroring will be highly recommended to use for its 100% fault tolerance and faster read operations. This will enable the users to get access to their data with highest speed and system will make sure that even if one disk gets corrupted, the data is still there for further operations.

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